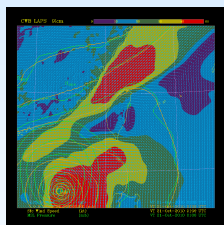


- CWB collaborate with GSD/ESRL/NOAA to develop CWB-LAPS for very short range forecast since 2002.

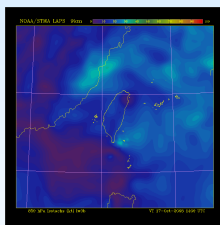
- Goal : Using the model outputs as the objective guidance to forecast the short-lived severe weather systems in Taiwan area.

## 1. Application of LAPS and STMAS

At CWB, LAPS and STMAS update every hour with the latest local observations. The outputs from LAPS and STMAS are applied to the real-time weather analysis and forecast.

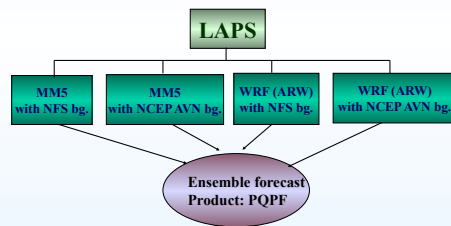


•LAPS analysis



•STMAS analysis

## 2. Operational products of LAPS forecast system

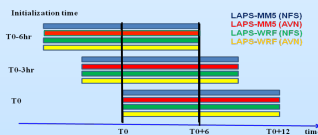


### 1. Deterministic forecast:

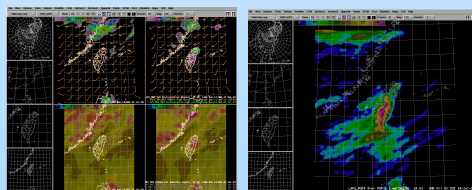
- LAPS-MM5(CWB NFS), LAPS-MM5(NCEP AVN), LAPS-WRF(CWB NFS), and LAPS-WRF(NCEP AVN)
- Horizontal resolution: 9 km
- Forecast time: 00, 03, 06, 09, 12, 15, 18, 21 UTC
- Forecast lengths: 12 hours

### 2. Ensemble forecast product:

PQPF(Probability Quantitative Precipitation Forecast) of LAPS forecast system is generated based on the time-lagged multi-model ensemble forecast which is composed of the latest 3 runs of the 4 model outputs (12 members).



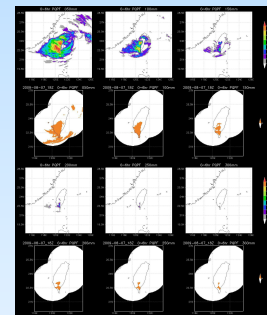
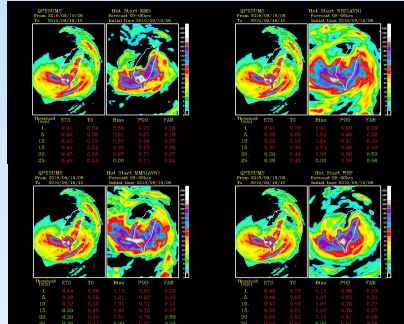
- The deterministic model forecasts and PQPF are real-time displayed on CWB WINS.



## 3. Real-time verification, statistical verification and PQPF calibration

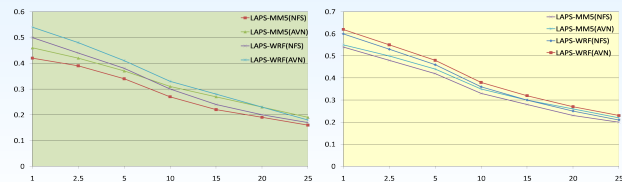
### (1) Real-time verification products

- PQPF of each model vs. radar QPE
- PQPF vs. radar QPE at different thresholds



### (2) Statistical verification products

TS of 6-h precipitation of each models for the Mei-yu cases(left) and typhoon cases(right) in 2009 at different rainfall threshold (unit: mm)



### (3) PQPF calibration

- Linear regression method is adopted to calibrate PQPF.

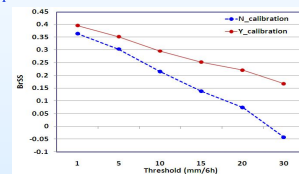
- Brier skill score (BrSS):

$$BrSS = 1 - \frac{BrSc}{BrSc_{ref}}$$

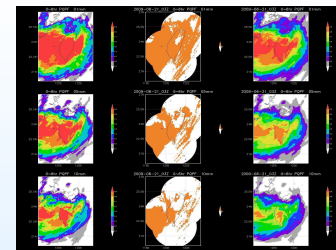
BrSc : referenced Brier score  $BrSc = O_{avg}(1 - O_{avg})$

$O_{avg}$  : sample climatology frequency

range :  $-\infty \sim 1$ ; BrSS > 0: skillful; BrSS = 1: perfect



•Brier skill score (BrSS) of 0-6h PQPF for the typhoon cases of 2009 • Blue line: BrSS without calibration; red line: BrSS with calibration



•Left column: PQPF without calibration; middle column: Radar QPE; Right column: PQPF with calibration for 0300UTC 21th June 2009 (Typhoon Linfa)

## 4. CWB LAPS webpage

All real-time analyses, forecasts and verification products of LAPS are available on CWB webpage.

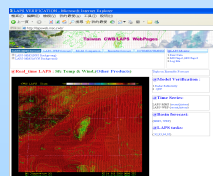
- Analysis products: LAPS and STMAS

- Forecast products:

LAPS-MM5(CWB NFS), LAPS-MM5(NCEP AVN), LAPS-WRF(CWB-NFS) and LAPS-WRF(NCEP-AVN)

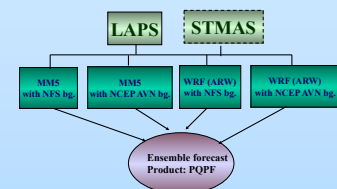
- Verification products:

Model rainfall forecasts vs. Radar QPE



## 5. Future work

STMAS will connect with MM5 and WRF as LAPS. In this way, there will be 4 new members in LAPS forecast system.



The PQPF generated from the 8 multi-models will be more referable for operational weather forecast.